Vol. 14 September, 1949 No. 3

CASTANEA

The Journal of the Southern Appalachian Botanical Club

CONTENTS

PUBLISHED FOR THE CLUB
MARCH, JUNE, SEPTEMBER, DECEMBER
at
West Virginia University
Morgantown, W. Va.

THE SOUTHERN APPALACHIAN BOTANICAL CLUB

All persons interested in the botany of the Southern Appalachian Mountains are invited to join the club. Dues, including subscription to the Journal, are $3.00 per year. Single copies of *Castanea*, seventy-five cents.

Notes and short scientific papers relating to the botany of the region are welcomed and will be published to the extent that the size of the Journal allows.

Authors will receive six gratuitous copies of the issue in which their papers appear. Separate reprints, if ordered in advance, will be furnished at cost.

CASTANEA

The Journal of the Southern Appalachian Botanical Club

Vol. 14 September, 1949 No. 3

Noteworthy Plants of Georgia

ARTHUR CRONQUIST

During the spring and summer of 1948 I had opportunity to make rather extensive plant collections in Georgia. The work was supported in part directly by the University of Georgia, and in part by a grant-in-aid from the Carnegie Research Committee of the University Center in Georgia. Since I am transferring my major botanical activities to the Pacific Northwest, it seems advisable to place on record at this time certain notes accruing chiefly from my field and herbarium work of 1948. Through the kindness of Dr. George H. Boyd, director of research at the University of Georgia, I have been able to visit the United States National Herbarium, the Academy of Natural Sciences of Philadelphia, the New York Botanical Garden, and the Gray Herbarium of Harvard University as an aid in the preparation of this paper. The new entities proposed are presented first, followed by a discussion of some unusual habitats and their more noteworthy plant inhabitants. In conclusion, some additional state records and comments are listed in Englerian sequence. Except as otherwise noted, all specimens cited are in the herbarium of the University of Georgia. Most of my own collections are in sets of ten or more and will be distributed to major herbaria.

PYRUS ARBUTIFOLIA **arbutifolia** Cronquist, var. nov.

Mespilus arbutifolia L. Sp Pl. 478. 1753, sens. strict.

PYRUS ARBUTIFOLIA **glabra** Cronquist, var. nov. A var. arbutifolia differt foliis glabris vel mox glabratis.

Type: *Duncan 4659*, fine sandy soil in wet open pinelands southeast of Jesup, Wayne County, Georgia, April 10, 1942; University of Georgia Herbarium number 23451. The specimen bears both flower and fruit.

Additional specimens: *Cronquist 4918*, 5 miles west of Brunswick, Glynn County, Georgia; *Cronquist 4939*, sandhills 3 miles west of Reidsville, Tattnall County, Georgia; *Duncan 1261*, 2 miles north of Midway, Liberty County, Georgia; *Pyron & McVaugh 249*, 2 miles west of Brunswick, Glynn County, Georgia; *Pyron & McVaugh 1466*, 6 miles southwest of Folkston, Charlton County, Georgia; *Pyron & McVaugh 2280*, 1 mile west of Howard, Taylor County, Georgia; *Clark s.n.*, 2.5 miles north of Leslie, Sumter County, Georgia; *Duncan 5927*, 16 miles northeast of Charleston, Berkeley County, South Carolina; *Travis 388*, Tilghman's Island, Talbot County, Maryland; *Fender 1360*, near Peermont, Cape May County, New Jersey.

Most of the specimens cited above have the expanding young leaves evidently hairy, becoming glabrous before they reach full size. My number *4939* has only a very few hairs, which fall off when the leaf is scarcely out of the bud. Both of my collections are low, simple-stemmed or only slightly branched, and have well developed creeping rhizomes. Most of the other collections seem also to be relatively little-branched, and further observation may well prove the habit to be a significant feature of this glabrate variety.

On account of its glabrous leaves, the variety here proposed might well be confused with *Pyrus melanocarpa*, but it has the late-maturing, long-persistent, bright red fruits of *P. arbutifolia*. *P. melanocarpa*, with early-maturing, soon deciduous, black or blackish fruits, seems to be of northern affinities, and I have not seen a specimen definitely so referable from south of White County, Georgia, in the Blue Ridge. It is not improbable that records of *P. melanocarpa* from the southern coastal plain are in fact based on *F. arbutifolia* var. *glabra*.

Euphorbia gracilior Cronquist, sp. nov. Glabrous perennial from a short, slender, upright underground stem which passes into a short slender taproot; aerial stems several, arising as branches from near the top of the underground stem, slender, erect, 1–3 dm. tall, loosely or sparingly branched, leaves entire, opposite, or the lower alternate, exceedingly variable, from linear-oblong or oblanceolate to elliptic or obovate, often shorter than the internodes, up to 4 cm. long and 2 cm. wide, narrowed to a sessile or shortly petiolar base, the upper reduced, or at least not larger nor more crowded than the other; stipules wanting; branches terminating as slender peduncles; involucres scattered, 1.5–2 mm. high, purplish especially upwards; appendages of the glands forming a thickened, deep red-purple rim; capsule smooth

or minutely roughened; seeds 2–3 mm. long, coarsely and shallowly pitted.

Ab E. ipecacuanhae differt radice graciliore, caulibus erectis minus ramosis, involucris purpurascentibus appendicibus crassis purpureis.

Type: *Cronquist 5334*, among scattered scrub oak and palmetto in very pale gray sand, sandhills 3 miles northwest of Reidsville, Tattnall County, Georgia, June 16, 1948; to be deposited at the United States National Herbarium. Isotypes to go to the University of Georgia, the New York Botanical Garden, the Missouri Botanical Garden, the Academy of Natural Sciences of Philadelphia, Harvard University, the University of Michigan, Southern Methodist University, the University of California, and the State College of Washington.

Additional specimens: *Cronquist 4933*, same station as the type; *Cronquist 5035*, 5 miles northeast of Newington, Screven County, Georgia; *Pyron & McVaugh 1458*, 2 miles east of Folkston, Charlton County, Georgia; *Pyron & McVaugh 1706*, 10 miles northeast of Wrens, Richmond County, Georgia.

This species is evidently related to *Euphorbia ipecacuanhae* L., from which it differs in its more slender root, more erect, less branching habit, and thickened, purple appendages of the involucral glands. It is the plant treated in John K. Small's Manual of the Southeastern Flora as *Tithymalopsis gracilis*, the name being based on *Euphorbia gracilis* Ell. Unfortunately, Elliott's name is antedated two years by the validly published *Euphorbia gracilis* Besser, and is thus illegitimate. I have here proposed a new species, rather than a new name based on *Euphorbia gracilis* Ell., because the identity of Elliott's plant has been questioned. The type does not appear to be in the Elliott herbarium at Charleston, and in at least one major herbarium it is considered to be probably the same as *Tithymalopsis zinniiflora* Small, a plant quite different from the one here described.

Euphorbia gracilior is rather common in sandhills and dry sandy pinelands in the coastal plain of Georgia. Its range is indicated by Small to be from South Carolina to Florida.

Bumelia thornei Cronquist, sp. nov. Thorny shrub about 1.5 m. tall, seeming to combine the characters of *B. lanuginosa* (Michx.) Pers. and *B. reclinata* (Michx.) Vent.: leaves entire, mostly elliptic or elliptic-oblanceolate, 1.5–4 cm. long, 6–20 mm. wide, short-petiolate, evidently veiny, glabrous above, persistently but rather loosely and not densely wooly-villous beneath, the hairs grayish or

rufescent; corolla about 3 mm. long, the erose, deltoid-ovate staminodes nearly equaling the lobes; anthers barely over 1 mm. long; ovary sparsely or moderately hairy; style about 1 mm. long; fruit subglobose, about 8–10 mm. long.

Frutex spinosa gracilis ca. 1.5 m. alta, foliis integris ellipticis vel elliptico-oblanceolatis 1.5–4 cm. longis 6-20 mm. latis reticulato-venosis supra glabris infra moderate lano-villosis, ovario sparse vel moderate piloso, style ca. 1 mm. longo, fructibus subglobosis ca. 8–10 mm. longis.

Type: *Thorne 7345*, dry live oak woods by cypress swamp, 1 mile east of Nantz Spring, Early County, Georgia, October 22, 1947; University of Georgia Herbarium no. 29170. Duplicates to be distributed by the collector.

Additional collections: *Thorne 1851*, near Mossy Pond, Baker County, Georgia, to be distributed by the collector; *Thorne 4895*, near Mossy Pond, Baker County, Georgia, to be distributed by the collector; *Thorne 6488*, Ichawaynochaway Creek, 3.5 miles west of Leary, Calhoun County, Georgia, to be distributed by the collector; *Eyles 7075*, edge of limesink pond, in southern Baker County, Georgia.

Bumelia thornei combines the low, slender habit and small leaves of *B. reclinata* with the pubescence and larger fruit of *B. lanuginosa*, though the fruits are not quite so large, nor the pubescence quite so dense, as in typical *B. lanuginosa*. It may eventually prove to be a hybrid, or more probably a species of hybrid origin, stabilized by amphiploidy or some other means. In any case, its known occurrence at four stations, in three counties of Georgia, demands that some nomenclatural recognition be made of its existence. It does not seem wise to subordinate it or either *B. reclinata* or *B. lanuginasa*, since I have seen no evidence of intergradation with either. The plant is named for Dr. Robert F. Thorne, who discovered it at three stations, and who suggested in transmitting the specimens that it might prove to be undescribed.

One of the most interesting habitats in Georgia is furnished by a deep, narrow, cliff-bordered canyon in Lookout Mountain, east of Trenton, in Dade County. Locally known as Sitton's Gulch, it is being developed as a state park under the name Cloudland Canyon. Here, amid scenery reminiscent of the far West, many northern or high mountain plants such as *Rubus odoratus* L. (No. 5284) and *Muhlenbergia tenuiflora* (Willd.) B.S.P. (no. 5284) reach low elevations of only about a thousand feet, and a well-developed beech

- - sugar maple - hemlock forest occupies part of the canyon. The area is part of the Appalachian or Cumberland Plateaus, and a number of plants characteristic of this geologic province occur. Among these is *Spiraea virginiana* Britton. Although this species is listed in the manuals as occurring south only to North Carolina and Tennessee, there is a specimen collected by *Ruth* (No. 281) at Lulu Falls, Lookout Mountain, Georgia, at the New York Botanical Garden, in addition to my own number *5299* from Cloudland Canyon which is now being distributed. *Silene rotundifolia* Nutt., a seldom-collected Appaachian Plateau endemic, has regularly been stated to occur in Georgia, although no collections from the state were mapped by Hitchcock and Maguire in their recent monograph of the North American species of Silene (University of Washington publications in Biology, volume 13, 1947). My number *5627*, from Cloudland Canyon, confirms the accuracy of the traditional statement. Further exploration of this area will doubtless reveal the presence of other characteristic Cumberland plants not yet known to occur in Georgia.

In the Folded Appalachians, or Ridge and Valley province, near Ringgold, in Catoosa Co., Georgia, are considerable areas of flat-lying limestone. Here occur a number of characteristically more western plants, having their centers of distribution in the Ozark region of Arkansas and Missouri. *Sporobolus heterolepis* Gray (no. *5621*, 10 miles west of Ringgold), although it extends far eastward in the glaciated area to the north, is one of these. In the unglaciated area it is not otherwise known eas of the Mississippi River. *Rudbeckia grandiflora* Gmel. (no. *5388*, 2.5 miles northeast of Ringgold) and *Silphium asperrimum* Hook. no. *5392*, 2.5 miles northeast of Ringgold) are two more such characteristically western plants. *Heliotropium tenellum* (Nutt.) Torr. (no. *5620*, 10 miles west of Ringgold), although already known from as far east as Alabama, likewise has its center of distribution in the Ozark area.

Two species of *Baptisia* taken from the same station as the *Rudbeckia* and the *Silphium* mentioned above seem to be of western affinities. Number *5391* matches *Baptisia leucantha* T. & G. in the restricted sense of Miss Larisey's monograph (Ann. Mo. Bot. Gard. 27: 119–244. 1940), and number *5389* seems to be identical with the western *B. leucophaea* Nutt. The taxonomic status of our southeastern *Baptisiae* needs further consideration, however, especially in view of the discovery in Alabama of a *Baptisia* of the *B. leucantha* type of Roland Harper (*Harper 3669*, Tuscaloosa County, Alabama, in several

major herbaria). The geographic disjunction of the southeastern from the Ozarkian species of this group, which was evidently a major factor in Miss Larisey's decision to segregate the southeastern plants into two new species and restrict the name *B. leucantha* to the more western plants, is now shown to be imperfect.

An acid bog in the Piedmont just east of Villa Rica, in Douglas County, Georgia, containing an abundance of characteristic coastal plain plants, was called to my attention by Dr. Rogers McVaugh. My number *5417*, from this station, was stated by Dr. R. E. Woodson to be the first collection of *Asclepias rubra* L. that he has seen from Georgia. This species has been confused with *A. purpurascens* L., so that earlier published accounts of its range are open to question. Two plants of northern affinities occuring in this same bog may be mentioned: *Lysimachia longifolia* Pursh (no. 5422) is recorded in the various manuals as extending south only to Virginia. *Veronicastrum virginicum* (L.) Farw. (no. *5421*) was recorded in Georgia from only a single *Chapman* specimen from near Rome, in Pennell's treatment of the *Scrophulariaceae* of eastern temperate North America (Academy Nat. Sci. Phila. Monogr. 1. 1935).

Since my plants were distributed, I have received a note from Dr. Edgar T. Wherry that "Your No. 5416, from Villa Rica, distributed as *Phlox carolina* is actually *P. maculata* var. *pyramidalis* (Smith) Wherry. This is the first record I have seen from south of North Carolina and Tennessee (reports from south to Florida are based on all kinds of misidentifications)."

Bromus purgans L. var. *laeviglumis* (Scribn.) Swallen is recorded in Hitchcock's Manual of the Grasses of the United States (under the name *B. ciliatus* var. *laeviglumis*) from as far south as North Carolina. My number *5551*, from Mill Creek, near Tate City, Rabun County, Georgia, at an elevation of about 3000 feet, extends the known range barely across the state line of Georgia. Associated with the *Bromus* at this station, less than a mile from the North Carolina border, was *Muhlenbergia tenuiflora* (Willd.) B.S.P., which has only recently been recorded from Georgia, and is not yet definitely known from North Carolina. It seems highly probable that future collectors will find it in North Carolina.

Panicum malacon Nash is listed in Hitchcock's Manual of the Grasses of the United States as occurring only in North Carolina and Florida. Mr. J. R. Swallen writes me of my number *5339*, from sandhills 3 miles northeast of Reidsville, Tattnall County, Georgia, that

it "fills in the distribution of this species from South Carolina to Florida."

Panicum huachucae Ashe, sens. strict., has not been known to extend south of North Carolina in eastern U. S. My number *5165*, from an old field east of Trenton, Dade County, Georgia, has been identified as this entity by Mr. J. R. Swallen.

Carex pennsylvanica Lam. was known by Mackenzie (N. Am. Fl. 18: 197. 1935) to extend only as far south as North Carolina and Tennessee. My number *5062*, from Rocky Face Mountain, 4 miles northwest of Dalton, Whitfield County, Georgia, and *Jones 545*, from near Mt. Berry, Floyd County, Georgia, extend the known range into Georgia. There are also several collections from Alabama by Roland Harper in major herbaria.

Cassia deeringiana (Small & Pennell) Macbride has been known only from southern Florida. My number *5516*, from sandhills 3 miles north of Butler, Taylor County, Georgia, is clearly identical with the Florida plant.

Cuscuta rostrata Shuttlew is listed in the regional floras as occurring south to Georgia, but the monographer, Dr. T. G. Yuncker, informs me that my number *5553*, from moist places near Mill Creek, above Tate City, Rabun County, Georgia, at an elevation of about 3500 feet, is the first collection of the species that he has seen from the state. This number is not included in my current sets, but will be distributed later by my colleague, Dr. Wilbur Duncan.

Phlox pilosa L. var. *ozarkana* Wherry, was described from Arkansas and Missouri. My number *5067* from Rocky Face Mountain, near Dalton, Whitfield County, Georgia, has been identified as this entity by Dr. Wherry, who also states that it has been collected near Warm Springs, Georgia, by Mrs. J. Norman Henry.

Satureja ashei Weatherby has been known only from the lake region of peninsular Florida. My number *5335*, from sandhills 3 miles northwest of Reidsville, Tattnall County, Georgia, extends the range well into Georgia.

Liatris pauciflora Pursh, in the restricted sense as defined by Miss Gaiser (Rhodora 48: 281. 1946), is known to Dr. Gaiser only from Florida, and from the type collection, in Georgia without definite locality. My number *5602*, from the margins of a moist swale in sandhills 3 miles northwest of Reidsville, Tattnall County, Georgia, provides a definite Georgia locality for the species.

Solidago radula Nutt. is a chiefly Ozarkian species which has also been found, in a larger-leaved form, in North Carolina. Two specimens in the University of Georgia herbarium, collected by Dr. Wilbur H. Duncan, show that the species also occurs in Georgia: *Duncan 3636,* Suwannee Mt., Forsyth County; *Duncan 4138a,* Yonah Mountain, White County.

Since my reduction of *Seriococarpus* to a subgroup of *Aster* I have been queried regarding the proper name for the plant which appears in the current manuals as *Sericocarpus bifoliatus* (Walt.) Porter. *Conyza bifoliata* Walt., on which Porter's transfer to *Sericocarpus* was based, is a later homonym of *Conyza bifoliata* L., and thus under Article 45 of the International Rules of Botanical Nomenclature carries no priority. The earliest available name for the plant seems to be *Aster tortifolius* Michx. Should one wish to retain *Sericocarpus* in generic status, the proper name becomes *S. tortifolius* (Michx.) Nees.

Silphium mohrii Small is a well-defined local species of Georgia, Alabama, and Tennessee. One of its most characteristic features, however, seems to have escaped critical notice. The basal and lowermost cauline leaves are characteristically very large and long-petiolate, while those above are relatively few, much smaller, and progressively reduced, becoming sessile. The habit, combined with its shaggy pubescence, makes the species readily recognizable.

WASHINGTON STATE COLLEGE
PULLMAN

An Analysis of Seedling Progeny of an Individual of Quercus Saulii Compared with Seedlings of a Typical Individual of the White Oak (Quercus Alba) and a Typical Rock Chestnut Oak (Quersus Montana)

H. A. Allard

Introduction

It is not unusual to find oak trees with unmistakably hybrid features in the two distinct groups of eastern oaks, the white oak group and the red oak group. That hybrids occur between the members within these two groups is obvious to a student familiar with oaks in the field. These hybrid oaks are distinguished by a multiplicity of intermediate characteristics in many instances, which may appear in the leaves, the autumnal coloration or the acorns. Spontaneous hybrids appearing in nature leave no historic records at to how, when or where they occurred. One can only surmise as to the origin of the tree in question. Whether it is a first generation derivative, an individual of a later generation, or some back-cross is quite unknown. There has been comparatively little study of our hybrid oaks and their progenies, and even less study of progenies derived from controlled crosses involving pure or line-bred parents of the species crossed. There is marked variation within most species of oaks, and some of these variations have appeared so distinctive that they have been considered of varietal importance by some botanists. A number of these appear to have more or less definite geographical limitations. *Quercus alba* var. *latiloba* Sarg. and *Q. alba* var. *repanda* Michx. f., may be mentioned in this connection. The former with shorter lobes and shallower sinuses, is more common than the typical, very deeply lobed form generally, especially in more northern regions 1/2/. The latter is said to be more abundant in parts of Louisiana and, in certain counties in Illinois 1/3/.

The so-called species *Quercus saulii* Schneid. is one of the commonest forms occurring in the range occupied by *Quercus alba* and *Quercus montana*. There is little question of its hybrid nature, and its affinities with the two species mentioned. However, observation indicates that the heterozygous complex resulting from the cross, has given rise to many forms differing in leaf shape, lobing, pubescence, acorn characters and other features. As a result of its hybrid nature

involving many genes and other genetic mechanisms, the species or the hybrid segregates, more properly speaking, show much variability.

The writer has grown progenies of several trees which would be pronounced *Quercus saulii*, and these have shown great individual variability in leaf form, the shape and lobing ranging from white oak characteristics to those typical of *Quercus montana*.

It is impossible for any individual botanist to grow many successive generations of oaks from the acorn stage. At least 15 or 20 years may be required to bring an acorn to the maturity of a bearing tree. However, leaf characters may be studied from the earliest stages of germination, and much can be learned of these within relatively few weeks or months during the first year of growth. The number of lobes and their characters, and the pubescence of progenies of *Quercus alba* and *Q. montana* in the first year seedling stage are as distinctive as in the mature tree. These features are just as distinctive in the

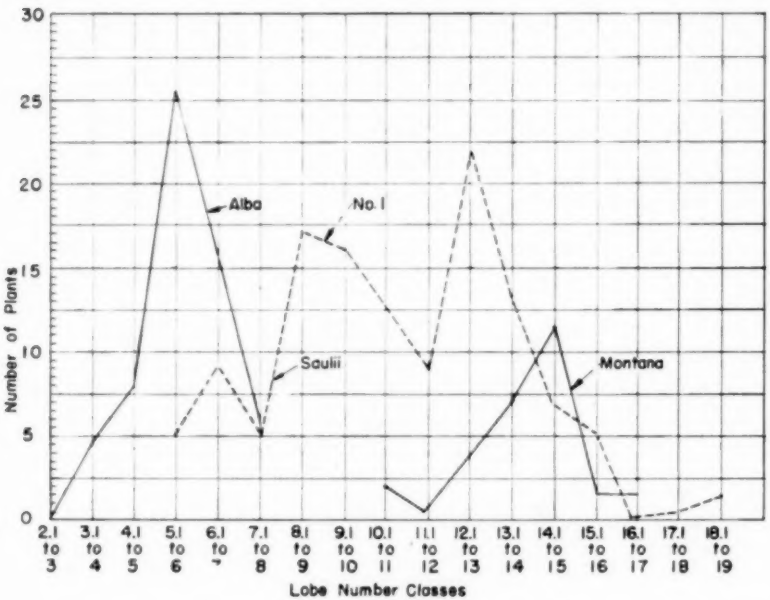

Figure 1.—Frequency distribution of seedlings of **Quercus alba, Q. saulii** and **Q. montana** classified according to the mean total number of lateral lobes per leaf. This was determined from a count of the lobes of all the leaves of the plant; 34 plants of **alba**, 125 plants of **saulii** and 29 plants of **montana** are represented. The distinctness of **alba** and **montana** from each other, and the intermediate condition in the hybrid **saulii** are at once obvious, even in the seedings.

individuals of progenies of *Q. saulii*. While certain juvenile features may be expressed also specific differences are unmistakably obvious.

The writer made an analysis of seedlings of a particular individual of *Quercus saulii*, together with seedlings of a typical parent of the *Quercus alba* and of *Q. montana* for comparison. The result of this study will be presented in the discussion following. A study of a progeny derived from *Q. alba* will be first presented. This will be followed by a study of a progeny of *Q. montana*. A presentation of data of the progeny of an individual tree of *Q. montana* next will be presented. The study deals with the number of lobes on a side as well as for the entire leaf, not including the apical lobe, and the character of pubescence of the leaves, petiole and twigs.

The lateral lobes of each leaf were counted for every leaf on the seedlings of each group and recorded for each side of the leaf as well.

An analysis of the mean number of lobes per leaf was made for each plant. The mean number for the entire plant was obtained by a summation for all the leaves divided by the number of leaves per plant.

Quercus alba

Acorns of a typical white oak tree, of the form sometimes distinguished as var. *latiloba*, growing in the writer's yard at Arlington, Va., were planted in small pots, one acorn in each pot, October 10, 1943. These had already sprouted when gathered. These were grown in the warm greenhouse until January 3, 1944, when they were cut to the ground and carefully pressed. At this time they had reached a height of 3 to 3½ inches.

The lateral lobes of each leaf were counted for every leaf on the seedling, and recorded for each side of the leaf as well. The leaves of these seedlings ranged in number from 2 to 6. Fifty-eight plants were grown, with the following distribution in leaf number: 2 plants with 2 leaves; 14 with 3 leaves; 25 with 4 leaves; 14 with 5 leaves; 3 with 6 leaves. A total of 234 leaves was studied. The lateral lobes counted on each edge totaled 378 and 374, respectively, giving a mean of 2.76 as compared with 2.73 lobes for each edge, or an average of 5.61 per leaf for 234 leaves studied.

The mean number of lateral lobes for all the leaves of a plant ranged from 3 to 8. These were arranged in frequency classes with the following distributions found. Number of plants with 3.1 to 4.0 lobes = 5; 4.01 to 5.0 = 8; 5.1 to 6.0 = 26; 6.1 to 7.0 = 14; 7.1 to

8.0 = 5. This data indicates that 68.9% of the plants fell in the classes having 5.1 to 6.1 lobes per leaf.

The character of pubescence of this progeny was typical of seedlings of *Q. alba*. The leaves of many plants were distinctly glabrous beneath, as well as the petioles, buds and twigs. Others bore beneath and on the petioles and twigs more or less loose, webby, tangled, deciduous pubescence that was readily rubbed off.

Quercus montana

Twenty-nine seedlings of a large, typical parent tree were grown and handled in the same manner as for the *Q. alba*. The number of leaves per plant ranged from 2 to 5, with the following distribution: 2 plants with 8 leaves; 3 with 9; 4 with 7; 5 with 5.

The progeny of this individual chestnut oak gave a mean of 14.25 lateral lobes per leaf. The total number of lobes for the same edge of all the leaves was 672 for one, 696 for the other, giving a mean of 7.00 and 7.25, respectively, for each edge.

The number of lobes per leaf for the different plants ranged from 10.00 to 17.0. These were arranged in frequency classes with the following distribution: 10 to 11 lobes per plant = 2 plants; 11.1 to 12.0 = 1; 12.1 to 13.0 = 4; 13.1 to 14.0 = 7; 14.1 to 15.0 = 11; 15.1 to 16 = 2; 16.1 to 17 = 2.

It is seen that there is no overlapping of classes expressing the number of lobes per leaf for *Q. alba* or *Q. montana*, since the highest number of lobes of any plant in the *alba* assemblage was 6.1 to 7.0. The lowest number in *montana* was 10 to 11 lobes per leaf per plant.

Without exception the undersurface of all the leaves of this progeny was covered with a close, dense, permanent pubescence, entirely unlike that of *alba* even when pubescence was present in this species.

Quercus saulii

This tree was found in Columbia Gardens Cemetery, Arlington County, Virginia and was very distinctive, having leaf characters approaching *alba* in many features. The lobes were more prominent, separated with deeper sinuses, and were more numerous and regular, in this respect approaching *montana*. The acorns were very large with features derived from both parents.

The leaves of this tree approach very closely the form of leaf illustrated in Plate 172 of the monograph, The American Oaks, by William Trelease, 4/ which he called *Quercus alba* f. *rydeni*. He

placed this oak in two keys, one including the white oaks, *Albae*, the other including the chestnut oaks *Prinoideae*. This would indicate that he regarded it a hybrid form between *Q. alba* and *Q. montana*. The Arlington oak, it would appear, is a derivative of such a cross, some segregates of which have been named *Q. saulii*.

Acorns were sowed in the greenhouse October 11. These germinated October 21. On January 3, when the seedlings were 75 days old, and 3-3½ inches in height to the tip of the stem, they were cut off at the ground and pressed.

One hundred twenty-five plants were grown. As for the *alba* and *montana* lots, a count was made of all the leaves on each plant, and all the lobes of each edge of the leaves. The number of leaves per plant ranged from 1 to 6 and were distributed as follows: 1 plant with 1 leaf, 11 with 2 leaves; 56 with 3 leaves; 44 with 4 leaves; 10 with 5 leaves; 1 with 6 leaves.

A total of 4,591 lateral lobes was counted on the edges of 425 leaves, giving a mean of 10.82 lobes per leaf. There were 2,308 lobes on one edge and 2,283 on the other, giving a mean for each edge of 5.43 lobes and 5.37 lobes, respectively.

The mean number of lobes per leaf determined for all the leaves of each plant ranged from 5 to 19. When these were arranged in frequency classes, the following data were obtained: 5.1 to 6 lobes per plant = 6 plants; 6.1 to 7 lobes = 9 plants; 7.1 to 8 lobes = 5 plants; 7.1 to 8 lobes = 5 plants: 8.1 to 9 lobes = 17 plants; 9.1 to 10 lobes = 16 plants; 10.1 to 11 lobes = 13 plants; 11.1 to 12 lobes = 9 plants; 12.1 to 13 lobes = 23 plants; 13.1 to 14 lobes = 14 plants; 14.1 to 15 lobes = 7 plants; 15.1 to 16 lobes = 5 plants; 16.1 to 17 lobes = no plants; 17.1 to 18 lobes = no plants; 18.1 to 19 = 1 plant.

A table was made of the character of the pubescence and its distribution in relation to the mean total of lobes per leaf for all the leaves of each plant of this hybrid.

The data are presented in Table I. These data are of some interest since they indicate two rather distinct groups, one (1) falling chiefly in the lowest lobe-number classes, the other (2), with its mode entirely removed from this class and falling in much higher lobe-number classes. The former indicates *alba* affinities; the latter *montana* affinities. The classes (3) and (4) show intermediate characteristics. The loose, webby, deciduous character of the pubescence found in these plants appears to indicate closer affinity with the more pronounced *alba* group (1), while the more permanent pube-

Pubescence characteristics	Lobe Number Classes and Distribution of Plants														
	4.1-5	5.1-6	6.1-7	7.1-8	8.1-9	9.1-10	10.1-11	11.1-2	12.1-13	13.1-14	14.1-15	15.1-16	16.1-17	17.1-18	18.1-19
1) Leaves beneath, petioles and twigs glabrous or nearly so	0	5	4	2	6	1	1	0	0	0	0	0	0	0	0
2) Leaves beneath, petioles and twigs with close, permanent pubescence	0	0	1	0	4	6	8	8	20	12	6	5	1	0	1
3) Leaves beneath, petioles and twigs with more or less pubescence of a permanent nature	0	0	0	2	1	2	2	0	2	2	1	0	0	0	0
4) Leaves beneath petioles and twigs with a loose, webby, rugacious pubescence	0	0	3	1	8	8	1	0	1	0	0	0	0	0	0

Table I.—Distribution of pubescence characteristics of the leaves of the supposed hybrid, **Q. saulii** (125 plants), relation to the mean total number of lobes for all the leaves of the plant.

scence of group (3), would seem to relate it more closely with group (2).

It is exceedingly difficult to evaluate the various types of pubescence, and a fine degree of separation into the various classes indicated cannot be made with certainty.

Even in typical *alba* seedlings, the under surface of the leaves, the petioles and the twigs, apically, may be strictly glabrous, or bear a loose, webby deciduous pubescence.

The undersurfaces of typical *montana* seedlings, the petioles and apical portions of the twigs, on the other hand, are more densely clothed with a close, permanent pubescence.

If group (1) is combined with group (4) and group (2) with group (3) we obtain 41 plants or 32.8% showing strong affiliations with *alba*, and 84 plants or 67.2% showing more pronounced affiliations with *montana*.

The 3:1 hypothesis in this instance involving glabrous and pubescent leaves may be tested by the special chi-square formula $x^2 = S(X\text{-}m)^2/m$, in which the m's are in the ratio of 3:1. If we consider the more or less glabrous condition representing *alba*, =41, and the more or less close permanent pubescence 84, representing *montana*, we have, by substitution, $x^2 = \frac{(84\text{-}93.75)^2}{93.75} + \frac{(41\text{-}31.25)^2}{31.25}$.

Solving this equation we obtain 4.04. This chi-square appears to be very significant as it is near the true 3:1 ratio.

Discussion and Conclusion

From the discussion, the data of table 1 and the graphs of figure 1, it is obvious that the seedling progeny of the so-called *Quercus saulii* parent found in Columbia Gardens Cemetery is of hybrid origin involving the two species *Q. alba* and *Q. montana*. It is shown by the graphs representing the mean total number of leaves for each plane for typical *alba* seedlings, and for typical *montana* seedlings, that these two species are distinctly separated with respect to the number of lobes developed on the leaves. The graphs for the hybrid *saulii* show a spread into both groups through a distribution of intermediate forms. The mode or point of greatest frequency appears to lie in an intermediate position.

The characters and occurrence of pubescence, as shown in table 1, also indicate heterozygous conditions, involvng both *alba* and *mon-*

tana parentage, together with more or less intermediate expressions. From the fact that the strictly glabrous or nearly glabrous individuals fall in the classes having the fewest number of lobes, and the condition of close, permanent pubescence is confined mostly to those classes having the highest number of lobes, it is indicated that number of lobes is more or less correlated with the character and occurrence of the pubescence.

If all the individuals of the progeny of this tree could be preserved to maturity, it is probable that many in the group with fewest lobes would be considered varying forms of *alba* while many others in the group with the highest number of lobes would be considered forms of *montana*. The more extreme intermediates, with strong affinities of *montana*, would be considered *saulii* variants.

From the fact that a wide range of variation may be expected in these oak crosses, it does not appear to be good taxonomic procedure to give specific names to such casual survivals occurring in nature. *Quercus saulii* Scheid. is not a species in the true sense but a heterozygous hybrid form, often completely lacking genetic stability for this reason. If individual names must be used, the hybrid nature should be indicated. However, from the fact of variability in the intermediates, many dissimilar segregates may be named in any hybrid progeny. This leads to unnecessary confusion and uncertainty with a multiplicity of names. Typical *Quercus saulii* forms represent but one intermediate segregate, but there may be many others that cannot be readily classed as *saulii*. Already several segregates have been named resulting from the supposed cross *alba x montana*. There are *Q. saulii*, *Q. alba* var. *ryderi* Trelease, and possibly others. The *saulii* segregates appear to be widely distributed from New England to Alabama, indicating rather general natural hybridization between *alba* and *montana* with many surviving segregates. Varieties and some of the forms of *alba* which have been named may be nothing more than hybrid segregates resulting from various crosses. *Q. alba* var. *heterophylla* von Ettinghausen & Krasen, a form found at Bridgton, Cumberland Co., N. J., and discussed and illustrated by N. L. Britton in the paper "Peculiarly lobed leaves in *Quercus alba* L." Bull. Torr. Bot. Club 8:126, 1881, may be of this derivation.

Literature Cited

(1) Coker, W. C. and Totten, H. R. Trees of the southeastern states, 2nd ed., Illus. 1937.

(2) Deam, Charles C. Flora of Indiana. 1940.

(3) Sargent, Charles Sprague. Manual of the Trees of North America. 2nd ed. 1921.

(4) Trelease, William. The American Oaks. Mem. Nat. Acad. Sci. XX: p. 255, illus. 1924.

WASHINGTON, D. C.

Color Comparison of Leaves of Open and Shade Grown Holly*

E. H. TRYON

Introduction

In 1944 a project was started by the West Virginia Agricultural Experiment Station to develop and market crops which could be grown on poor agricultural land, particularly on steep slopes. A minimum of cultivation of such crops in order to prevent soil erosion as well as a short rotation to insure a reasonably quick income were needed. The development of these crops was termed "Hillculture", which implies a type of land use bridging agriculture and forestry.[1] American holly (*Ilex opaca* Ait.) for a Christmas green was the first crop on which the hillculture personnel worked, and marketing this holly was the first step. Investigations showed that only a superior type of holly should be marketed to satisfy the trade. Holly with leaves having poor color, spots caused by fungi or insects, or abnormal form was not always marketable. These findings therefore led to the decision to start investigations for determining proper methods of producing holly under such conditions that those desirable characteristics influenced by site could be obtained. In selecting a desirable site for the production of holly, the effect of shade from a natural canopy on the type of holly produced was first considered. A study was set up to determine how natural canopies of varying densities affected the development of the holly. The effect of these degrees of density of cover was investigated in relation to such factors as color of leaves, length of leaves, height, growth, size of crown, and number of leaves. The results of the investigation should indicate

[1]This project was financed largely by Sears Roebuck Agricultural Foundation.

*Published with the approval of the Director, West Virginia Agricultural Experiment Station, as Scientific Paper No. 399.

the desirability of growing holly either in the shade or in the open. This paper will consider only one phase of the investigation, that being the effect of natural canopy densities on the color of holly leaves. The purpose is to show whether holly should be grown in the open or in the shade of other trees in order to produce a more desirable color in the leaves.

Methods

Plots for the study were selected in Nicholas and Upshur Counties, West Virginia. Three criteria were observed in selecting the plots. First, the trees had to be reasonably uniform in size and ranging from about two to six feet in height. Second, both open and shade grown hollies had to be in the plot, but in so far as possible other factors of site should be the same. Third, the plots must be located in areas where grazing does not occur, because when an area is heavily grazed the holly will be browsed and the vigor affected. As holly generally is scattered, even within its natural range in the state, and as the plots had to be established on private property where grazing was common, difficulty occurred in locating plots which met the above three criteria. Six plots were established in 1946. Each plot contained a total of 42 trees, 14 in the open and 28 in the shade, making a total of 252 trees. The color values were measured in 1946 and 1947 and data from both years were used in the investigation, making a total of 504 measurements.

Determination of Light Intensity

The percentage of solar radiation or "light" was determined for each tree growing in the shade. A Photovolt Universal Photometer Model 200-A, employing a photoelectric cell which converts light energy into electric energy and indicates the amount of this energy on a galvanometer, reading directly in foot-candles, was used for all measurements. The photoelectric cell was equipped with a "visual correction filter" which removes the ultra-violet and infra-red sensitivity of the cell. Thus the wave lengths of light visible to the eye and most effective in photosynthesis of plants were measured by the instrument. As the instrument is capable of reading a maximum of only 500 foot-candles, and since light values in the open in summer sometimes exceed 10,000 foot-candles, baffle plates were prepared so that higher values could be measured with the instrument. These

baffles are merely circular discs constructed to reduce the area of the cell receiving the light rays. A baffle which has an area of one-tenth of the sensitive area of the cell reduces the reading to one-tenth of the actual value. Therefore, all readings of the galvanometer must be multiplied by ten when that baffle is used, so that the instrument which normally has a maximum of 500 foot-candles is then capable of reading a maximum of 5,000. In a like manner baffles may be prepared to measure desired maximum values. Figure 1 shows the photometer and three baffles.

Figure 1.—Photometer with baffle plates used to measure light intensity.

The percentage of sunlight reaching each holly growing in the shade was determined by averaging five readings around the tree and comparing this value with a reading taken in the open immediately afterwards. Of the five readings four were taken on north, east, south, and west bearings around the periphery of the crown and one at the terminal of the tree.

As the percentage of sunlight in a stand may vary with time of day and with atmospheric haze or clouds covering the sun, an attempt

was made to take all light readings on a bright day between 10 a. m. and 3:00 p. m. However, because of the time required to take the readings compared to the time avaiiable, some of the readings had to be taken when the sky was slightly overcast. Although this presumably detracts somewhat from the accuracy of the determination of percentage of sunlight in a stand, it still is believed to be accurate enough so that the results and conclusions presented here are entirely justifiable.

Although percentage of sunlight was used as a measure in determining the effect of the canopy on leaf-color, it is recognized that factors other than a reduction in light intensity are involved, such as differences in air temperature, humidity, transpiration rate, and soil moisture, particularly during dry seasons. Therefore, when discussing a low percentage of sunlight, all the other factors and their interactions are taken into consideration even though they have not been measured quantitatively.

Determination of Color of Holly Leaves

A color standard was needed in order to measure the color of holly leaves quantitatively. After an investigation into methods of color measurement the use of the Munsell method of color notation[2] was selected as the basis for such a standard.

From the Munsell Book of Color, groups of color combinations more than adequately covering the range of color of holly leaves were obtained and taken into the field. Hundreds of holly leaves representing the range of color found in the species were matched with Munsell colors, and with this information, colors were selected for the construction of the color standard.

The investigation of color of holly leaves indicated that they differed in values, or degree of darkness, from black to white; in chroma, or variation from neutral to a strong color; and in hue, in this case the proportion of green and yellow.[3] A two-way color chart was prepared using one hue of 5.0 Green Yellow (5.0 GY), and another hue of 7.5 greenish Green Yellow (7.5 GY), and combining

[2]See Munsell Color Company, Inc., Munsell Book of Color, Baltimore, Maryland, 1929.

[3]See Nickerson, Dorothy, Color measurement and its application to the grading of agricultural products. U.S.D.A. Misc. Pub. 580. 62 pp. 1946 for a good description of value, chroma, and hue.

values and chromas with them so that 1, degree of darkness and 2, proportion of green to yellow could be measured. The 12 following Munsell colors were used in constructing the chart:

7.5 GY 2/2	5.0 GY 2/2
7.5 GY 3/4	5.0 GY 3/4
7.5 GY 4/6	5.0 GY 4/6
7.5 GY 5/6	5.0 GY 5/8
7.5 GY 6/8	5.0 GY 6/8
7.5 GY 7/10	5.0 GY 7/10

In terms of hue, value, and chroma, the 7.5 GY and 5.0 GY are hues, and 2/2 to 7/10 represent value/chroma. The manner of placement of these colors on the chart is shown in Figure 2.

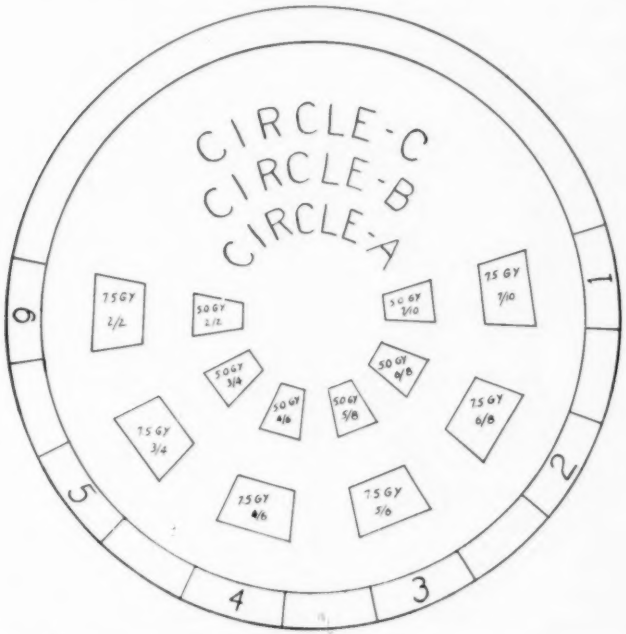

Figure 2.—Construction of color chart showing the Munsell color numbers for each of the twelve colors used.

The numbers from 1 to 6 in the outer circle represent colors from light to dark respectively in the range of color of holly leaves. The two circles, A and C, differ in hue, and Circle C has a higher

amount of green than does Circle A, although the degree of darkness is about the same for both circles having the same number on the chart. Thus a holly leaf having a color of 5.0 GY 4/6 could be recorded as 4A, and another being intermediate between 5.0 GY 3/4 and 7.5 GY 3/4 would be recorded as 5B. In order to simplify the analysis of the data, Circle A was given a value of 1, Circle B, a value of 2, and Circle C, a value of 3. Thus the higher the number the more green is the leaf.

In order to make comparisons of color in the field a wheel was constructed with the 12 colors discussed above and having an overlay to mask out colors not needed in the comparisons. This color wheel is shown in Figures 3 and 4.

Color of holly leaves varies from a lighter color on the current year's growth to a darker color on one- and two-year old leaves on the same tree, and as the season progresses the leaves of the current year become darker and a deeper green. In order to keep conditions as nearly identical as possible all color measurements were taken

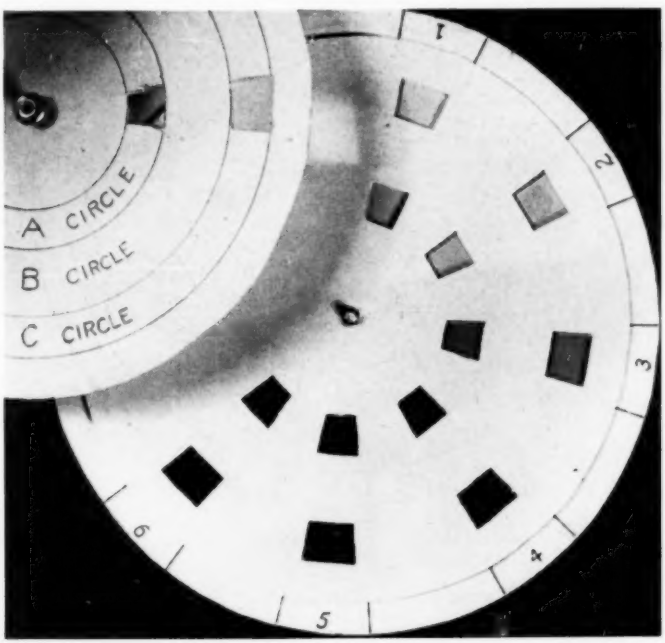

Figure 3.—Color wheel showing the arrangement of colors and the mask.

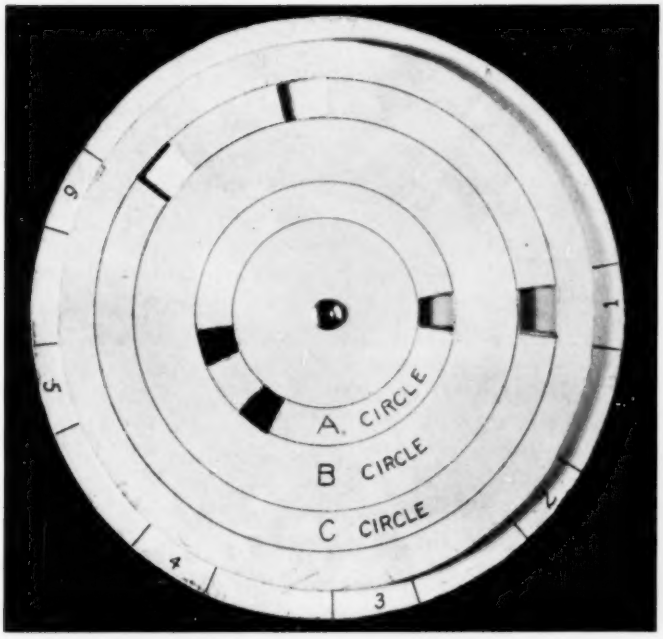

Figure 4.—Color wheel as used to determine color of holly leaves.

on one-year old leaves between September 1 and September 15 during the 1946 and 1947 seasons.

Ten one-year old leaves were selected in a random manner and picked from each tree and compared with the color chart. The comparisons were always made in the shade even for trees growing in the open so that direct rays from the sun on the chart would not affect the results. One value was recorded for each tree and when the ten leaves varied in color the average was taken.

Results

The degree of darkness as well as the relative proportion of green to yellow in holly leaves were compared in open and shade grown holly by the "t-test".[4] The results are presented in Table 1.

The amount of darkness was 4.13 in the open as compared with 4.12 in the shade. This slight difference is not significant as would be expected. Therefore, conditions occurring under a canopy have no effect upon the darkness of holly leaves.

[4]See Snedecor, George W. Statistical Methods. Ames, Iowa, xvi + 485 pp. 1946 for a description of this method of analysis.

Table 1

Relative Darkness and Amount of Green in Leaf-Color of Leaves Growing in Shaded and Open Sites

Condition Tested	Site		
	Shaded	Open	Difference
Relative darkness of leaves	4.12	4.13	-0.01
Relative amount of green in leaves	1.26	1.02	0.24**

**Significant at 1% level (highly significant).

The relative amount of green in shade grown holly is greater than in open grown holly when all degrees of shade are grouped together. The higher value of holly leaves in the shade, 1.26, is 0.24 greater than those open grown and this difference is highly significant. Therefore, shade increases the amount of green in holly leaves over those grown in the open.

In order to investigate the effect of different amounts of sunlight on greenness of holly leaves the data were separated into groups on percentage of sunlight. These data are presented in Table 2.

Table 2

Relative Amounts of Green in Leaves When Sites are Grouped by Percentage of Sunlight

Percentage of Sunlight Class	Number of Samples	Relative Amount of Green	Difference between Sunlight Class and Open
0-2	80	1.57	0.55**
3-5	40	1.21	0.19*
6-10	28	1.36	0.34**
11-20	50	1.23	0.21**
21-30	26	1.11	0.09
31-40	44	1.07	0.05
41-50	28	1.14	0.12
51-60	14	1.09	0.07
61-70	10	1.00	-0.02
71-80	14	1.00	-0.02
81-90	2	1.00	-0.02
Open	168	1.02	0

*Significant at 5% Level (significant).
**Significant at 1% Level (highly significant).

This table shows that differences in amount of green in the open and in the shade grown leaves do not vary significantly until the amount of sunlight has been reduced to 20 percent and below this point the relative proportion of green in the leaves is increased. In all percentage of sunlight-groups below 20 percent, 0-2, 3 5, 6-10, and 11-20, the differences are significant or highly significant. Therefore, a light shade and even one allowing penetration of 21-30 percent of sunlight is not effective in increasing the amount of green in the holly leaves, but when the sunlight is reduced below this point the relative amount of green in the leaves is increased.

It is of interest to note that holly was observed surviving and growing under extremely low light intensities. In an area in Nicholas County, West Virginia, which was included in one of the plots, seven young trees were growing in light intensities lower than one percent. The light data were obtained August 3, 1946 at 2:00 p. m. on a clear day. Readings in the open varied from 6,300 to 7,569 foot-candles. The values in the shade where the seven trees were growing were 15, 28, 30, 36, 41, 46, and 50 foot-candles. These trees ranged from two to four feet in height, with thin stems, and having few branches and leaves. The over-story was composed principally of large hemlocks which indicated that these hollies had lived their entire lives under such conditions. This would indicate that holly is capable of surviving under low light intensities. The soil on which these hollies were growing had a high water table and the trees apparently had ample water during the dry season which undoubtedly compensated to some extent for the low light intensities. Other areas were found also where hollies were surviving under light intensities of less than one percent.

Conclusions

The results of this investigation indicated that holly leaves growing under a natural stand allowing penetration of but 20 percent or less of sunlight had a higher proportion of green than those in the open or under a less dense canopy. These leaves with the higher content of green are more pleasing to the eye and should be preferred on the market to those having relatively more yellow in them. However, when the overstory is dense enough to favor a better color in the leaf, other changes take place in the holly plant which are not always desirable from the standpoint of raising the most marketable holly. A heavy overstory will cause holly to grow slowly, and to be

spindly with few branches and consequently few leaves. Thus, the amount of material that can be gathered for Christmas greens is reduced.[3] Fewer berries are produced on the female plant growing in heavy shade than in the open, according to observations. This is detrimental to the commercial production of holly in the state as the amount of holly which may be gathered and sold is reduced. An attempt has been made in West Virginia to keep the product natural in appearance and consequently neither artificial berries nor coloring of the leaves is used, and holly is gathered only from female plants having berries.

The results of the investigation showed no differences in color of the leaves of holly between those grown under conditions resulting from a light shade and those grown in the open. Therefore, for the conditions found in the holly areas studied in West Virginia, the best conditions for the production of holly are in the open or under a light shade, neither one being superior to the other.

Observations of holly trees growing in fields where fertilizer has been added for the production of other crops indicate that the color of holly leaves may be improved by proper fertilization practices. Such a method of improving the color of holly leaves would be superior to attempting to raise holly under a dense canopy.[3]

[3]A subsequent paper on holly which is now in preparation will present data substantiating these statements.

West Virginia Agricultural Experiment Station
Morgantown

NOTES and NEWS

WILBUR H. DUNCAN, *Editor*

PRESENTING SOUTHERN APPALACHIAN BOTANISTS

From time to time we plan to present in this department brief sketches of southeastern botanists. We begin with some of the botanists of Georgia.

Associated with Department of Botany, University of Georgia

BECK, EDWIN G. Associate Professor. A native of Wisconsin. B. S., Carroll College. M. A. and PH.D., University of Michigan. Came to Georgia, September, 1947. Duties are teaching and research in Physiology. Research interests:—Anatomy and physiology of insect galls. The nature of the gall stimulus. Bryophytes of Georgia. Research soon to be completed:—The anatomy and physiology of the *Solidago* gall caused by *Gnorimoschema gallaesolidaginis.*

CARLTON, WILLIAM M. Assistant Professor. A native of Wauchula, Florida. A. B., Miami University (Ohio) M. S., Louisiana State University. PH.D., University of Chicago. Came to Georgia in Feb., 1947. Duties: Teaching plant anatomy and microtechnique. In charge of the Elementary Botany program. Research interests:—Effects of growth-regulating substances of the internal structure of roots. Anatomy of *Phoradendron spp.;* Algae. Research soon to be completed:—Micro- and Megasporogenesis in *Manfreda virginica.*

DUNCAN, WILBUR H. Associate Professor. Early part of life spent in Indiana. A. B. and M. A., Indiana University. PH.D., Duke University. Came to Georgia in 1938. Duties:—Teaching and research in taxonomy of vascular plants. Curator of U. of Ga. Herbarium. Research interests:—Taxonomy of vascular plants. Flora of Georgia. Research recently completed:—Poisonous plants of Georgia. Research soon to be completed:—Vegetative survey of the Allatoona Dam impoundment area near Cartersville, Ga. Key to families of monocots of the Southeastern U. S.

JACOBS, DON L. Assistant Professor. B. A., M. S., and PH.D., University of Minnesota. Came to Georgia in Sept., 1948. Duties:—Teaching and research in ecology. Research interests:—Biology of

the duckweeds and certain other aquatics. Ecology of the bryophytes. Research recently completed:—Ecological life-history of *Spirodela polyrhiza*. A new parasitic dinoflagellate from fresh water fish. Shoot segmentation in *Anacharis densa*. *Wolffia papulifera* in Florida. Research in progress:—Flora of the big bend of the Minnesota River. Ecological life-history of *Lemna perpusilla*. Duckweeds of the Southeastern U. S.

WESTFALL, JONATHAN J. Professor and Head of Department. A native of West Virginia. B. S., West Virginia Wesleyan College. M. S. and PH.D., University of Chicago. Came to Georgia in Sept., 1947. Teaching and research in cytology and morphology. Research interests:—cytology and morphology.

WILSON, CHARLES C. Associate Professor. A native of Florida. B. S., University of Miami. M. A., and PH.D., Duke University. Duties:—Teaching and research in physiology. In charge of greenhouse. Research interests:—Growth regulators. Guard cells. Photosynthesis. Physiological basis of breeding. Research soon to be completed:—Effect of growth regulators on water relations of crop plants. Spectographic method for continuous determination of atmospheric CO_2

WOLFF, EMILY T. Assistant Professor. Early part of life spent in New England. A. B., Temple University. M. S. and PH.D., Pennsylvania State College. Came to Georgia in Sept., 1947. Research interests:—Mycology. Structure of industrial flowers.

Associated with Department of Plant Pathology, University of Georgia:

MILLER, JULIAN H. Professor and Head of Department. Almost entire life spent in Georgia. B. S. A. and M. S., University of Georgia. PH. D., Cornell University. Has been at University of Georgia since 1919. Teaching mycology and plant pathology. Research interests:—Taxonomy of the ascomycetes. Research recently completed:—A revision of the classification of ascomycetes.

THOMPSON, G. E. Associate Professor. A native of Ontario, Canada. B. S. A. and M. A., University of Toronto. PH. D., Cornell University. Came to Georgia in 1937. Duties:—Teaching and research in Plant Pathology. Research interests:—Rusts of Georgia. Seed Treatments. Grain and cotton diseases. Research soon to be completed:—Watermelon seed treatments.

Reprints should be ordered when galley proof is returned to the editor. Morgantown Printing & Binding Co., Morgantown, W. Va., have furnished the following rates:

Copies	2pp.	4pp.	8pp.	12pp.	16pp.
25 Copies	3.65	4.25	$ 530	$ 7.95	$10.60
50 "	3.80	4.50	5.80	8.70	11.60
75 "	3.95	4.75	6.30	9.45	12.60
100 "	4.10	5.00	6.80	10.20	13.60
150 "	4.40	5.50	7.80	11.70	15.60
200 "	4.70	6.00	8.80	13.20	17.60
300 "	5.30	7.00	10.40	15.60	20.80

Reprints will be folded and if more than four pages, saddle stitched. Covers similar to that of **Castanea**: First 50 copies, $2.00; Additional covers, 1½ cents each.